

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 6898-104	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/US 01/ 12724	International filing date (day/month/year) 18/04/2001	(Earliest) Priority Date (day/month/year) 20/04/2000
Applicant TRUETIME, INC.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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☐ None of the figures.

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 859 835 A (STILIADIS DIMITRIOS ET AL) 12 January 1999 (1999-01-12) abstract column 5, line 46 -column 9, line 19 column 15, line 51 -column 16, line 20 ---	1,2,6
X	US 5 394 395 A (NAGAI TETSUYA ET AL) 28 February 1995 (1995-02-28) the whole document ---	1,2,6
E	FR 2 808 345 A (IMEDI) 2 November 2001 (2001-11-02) abstract page 2, line 12-26 page 6, line 1 -page 8, line 18 page 13, line 1 -page 14, line 26; figure 6 --- -/--	1-12

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

1 February 2002

Date of mailing of the international search report

11/02/2002

Name and mailing address of the ISA

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>MILLS D L: "INTERNET TIME SYNCHRONIZATION: THE NETWORK TIME PROTOCOL" IEEE TRANSACTIONS ON COMMUNICATIONS, IEEE INC. NEW YORK, US, vol. 39, no. 10, 1 October 1991 (1991-10-01), pages 1482-1493, XP000275311 ISSN: 0090-6778 page 1483, left-hand column, line 12-25 page 1484, right-hand column, line 36-48 page 1485, paragraph A -----</p>	4, 10

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Information on patent family members

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Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 5859835	A	12-01-1999	US	6134217 A		17-10-2000
US 5394395	A	28-02-1995	JP	2829807 B2		02-12-1998
			JP	6030023 A		04-02-1994
FR 2808345	A	02-11-2001	FR	2808345 A1		02-11-2001

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference LA-6898-104 PC	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US01/12724	International filing date (day/month/year) 18/04/2001	Priority date (day/month/year) 20/04/2000
International Patent Classification (IPC) or national classification and IPC H04L12/00		
Applicant TRUETIME, INC.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:
 - I ☒ Basis of the report
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application

Date of submission of the demand 16/11/2001	Date of completion of this report 24.06.2002
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Kappatou, E Telephone No. +49 89 2399 7521 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT.

International application No. PCT/US01/12724

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-27 as originally filed

Claims, No.:

1-12 as received on 30/05/2002 with letter of 30/05/2002

Drawings, sheets:

1/23-23/23 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

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☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-12
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-12
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

- 2. Citations and explanations**
see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The subject-matter of claim 1 is new and involves an inventive step, Article 33(2)(3) PCT.
 - 1.1 Claim 1 refers to a method comprising the steps:
 - a. determining a scheduled time of transmission for each packet;
 - b. writing the scheduled time of transmission and the error checking code in each outgoing packet;
 - c. releasing the outgoing packet at the physical interface when the clock of this interface is equal to the scheduled time of transmission.
 - 1.2 Such a method is known from document D1: US-A-5 394 395.
 - 1.3 The problem to be solved by the present application may be regarded as providing a method of improving time precision in a network, without changing the transmission protocol.
 - 1.4 This problem is solved by determining with the other clock the reception time for the packet at the other interface and storing this time in an auxiliary timestamp external to the packet, without changing the error checking code. A synchronization of the clocks is done with the scheduled time data in the packet and the associated auxiliary timestamp.
2. This solution cannot be derived from the cited the prior art.
 - 2.1 Document D1 refers to a cell delay addition circuit. It does not refer to receiving of the cell or to the problem of synchronisation of two different network clocks.
 - 2.2 Document D2: US-A-5 859 835 refers to a traffic scheduling method for packet-switched networks. The method of D2 is suggesting putting a timestamp on the outgoing packets, that is calculated with the help of the system potential variable.

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This helps providing end-to-end delay bounds. This method does neither suggest to wait for the time to send out the packet, nor the use of an auxiliary timestamp at receiving the packet on the other side.

3. Independent claim 6, referring to an apparatus, has subject-matter corresponding to method claim 1 and is therefore also new and inventive.
4. Claims 2 to 5 and 7 to 12 are dependent on claim 1 and 6 respectively and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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1. A method for improving time precision in a network including a first clock and a second clock using a packet based network time protocol that is transmitted and received in accordance with a data packet transmission protocol that also includes a error checking code for use in detecting transmission errors in the received data packets, comprising the steps of:
determining a scheduled time of transmission when each packet containing network timing information is to be released for transmission from a respective first or second physical interface to the network,
writing the scheduled time of transmission and the associated error checking code in each outgoing information packets,
releasing each outgoing information packet at the respective physical interface when the first or second clock associated with that interface indicates that the current time is equal, within said predetermined precision, to the respective said scheduled time of transmission;
using the respective other clock to determine, within a predetermined precision, a time of reception when each released information packet is received at the other physical interface to said network;
storing said time of reception in an auxiliary timestamp external to the information packet in a manner that is transparent to said transmission protocol without any updating of said error checking code;
associating each auxiliary time stamp with the respective incoming information packet, using the time of reception data in the auxiliary timestamps and the scheduled time of transmission data in the information packets to synchronize the first clock to the second clock.
2. The method of claim 1 wherein said network time protocol is an existing time protocol, said transmission protocol is an existing transmission protocol.
3. The method of claim 2, wherein the arriving packets are sent to a receive buffer after the auxiliary timestamp has been stored.
4. The method of claim 3 wherein no changes are made to physical layer drivers or to any of ISO rules for packet structure, at all network layers.

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5. The method of claim 4, wherein at least one said physical layer is a host physical layer to a network boundary.
6. An apparatus for reducing the uncertainty in timing on a network comprising:
an auxiliary receive timestamp for associating an auxiliary timestamp to arriving packets before sending the packets to a receive buffer, wherein said auxiliary timestamp is in addition to any existing network protocol timestamp and does not require the recalculation of any existing error checking code before the packets are placed in said receive buffer;
a transmit timestamp adapted to apply a future timestamp for packets to be transmitted at a scheduled future time together with any associated error checking code, and
a network transmitter adapted to hold and release the transmitted packets from a physical interface according to said future timestamps.
7. The apparatus of claim 6 wherein:
the network is adapted to run according to ISO and TCP/IP rules, including packet structure rules including a CRC field; and
a media access controller extender apparatus transparent in operation to existing hardware, said media access controller extender being adapted to supply said auxiliary and future timestamps and utilize said auxiliary and future timestamps to reduce timing uncertainty on a network.
8. The apparatus of claim 6 wherein:
said network is an ISO layered network and follows the ISO rules for packets and networks;
and
said physical interface is a host physical layer to a boundary of the ISO layered network.
9. The apparatus of claim 7 wherein:
said receive and said transmit timestamps are transmit and receive times of packets at physical interfaces and are supplied after the packet leaves the application layer, or is read before the packet enters the application layer.
10. The apparatus of claim 6, wherein
said auxiliary timestampers are transparent to an existing network time protocol.
11. The method of claim 4, wherein the error check code is a CRC code, and a copy of the CRC code of a particular data packet is included in the associated auxiliary timestamp.

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12. The apparatus of claim 7, wherein said media access controller extender copies the contents of the CRC field into the associated auxiliary receive timestamp.